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ABSTRACT

This investigation of the impact of feedback upon scrambled discourse was intended to show the effects of idiosyncratic processing and to provide a more sensitive indicator of feedback usefulness. Learner schemata, text organization, and feedback strategies interact in processing discourse, although past research has favored limited models concerning text processing. Previously, the level of achievement was assumed to be enhanced by a high degree of concordance between learner outcomes and outcomes endorsed by the text author. This study assumes conceptual congruence is achieved by arriving at a sentence sequence close to that of the original order. Subjects were 54 undergraduate students who were presented with a set of randomly ordered cards, each containing a single sentence describing a part of the development of the first atomic bomb. Cards were to be rearranged according to meaning, and subjects given feedback could use five tokens to request information on correct placement of a sentence. A control group read the scrambled sentences twice without demands for reconstruction and took a follow-up test immediately. The experiment led to the conclusion that feedback is used in an idiosyncratic manner, depending on the strategies available to the learner, as well as the knowledge base. (LMO)

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Feedback and the Reconstruction of Meaning

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This study is one of a series of experiments, which started out innocently enough to investigate the impact of feedback upon scrambled discourse. Our innocence, to say the least, has been shattered.

Feedback is generally defined as some event subsequent to a response, which assists the learner in establishing the appropriateness of the response. Most instructional developers use feedback to adjudicate differences between the intent of the instructional program and perceived student outcomes (Langer & Keenan, 1984; Keenan, Langer, & Medosch-Schonbeck, 1985). However, the assumption of direct causality between an instructional stimulus (e.g., content, feedback) and subsequent cognitive processing is generally unproven (Winne, 1982; Bilodeau, 1969). Validation of any process based upon a product (i.e., a response) is difficult, since one has to prove there was no other way the student could have derived the response (i.e., alternative strategies).

The basic assumption among most instructional developers is that the organization of the discourse, either at the syntactical or conceptual level, is critical to such measures of achievement as recall and recognition (Reder, 1980). Indeed, research has clearly demonstrated that recall for prose is subject to the logic of the discourse (Frase, 1969; Kulhavy, Schmid, & Walker, 1977). What confounds the issue further is that the schemata available to the learner also appear to play a critical role in the discourse processing (e.g., Brooks & Dansereau, 1984). Hence we have an interesting and poorly defined interplay between three key factors in any instructional program: learner schemata, text organization, and feedback strategies which try to bridge the gap between unknowns. Previous feedback research has tried to dodge the bullet concerning these difficulties.

First of all, presently we have only somewhat limited models concerning how text is processed (e.g., van Dijk & Kintsch, 1984; Meyer & Freedle,

1984). Most research in feedback has tried to avoid the problems of discourse processing and unknown learner schemata by using tightly structured, even programmed passages. This tactic is designed to make the learner more dependent on external rather than internal (i.e., schemata) cues for content meaning.

The rationale among researchers has been a widely-held belief that feedback was a known quantity operating along some systematic general dimensions, although to be sure there were still heated discussions on the incentive-information issue, etc. (Getsie, Langer, & Glass, in press). However, at this moment, the systematic impact of feedback is now an open question.

Our original intent in using scrambled discourse was that it would encourage idiosyncratic processing, and might provide a more sensitive indicator of feedback usefulness (Langer & Keenan, 1984). Scrambled discourse probably occupies a niche in meaningfulness between nonsense syllables and organized prose. Previous research clearly suggests that subjects do not do as well with scrambled materials (e.g., Frase, 1969; Sasson, 1971; Tobias, 1973). However, with the exception of a study by Schultz and Divesta (1972), nothing has been done to assist learning in the scrambled presentation condition.

In an earlier study we decided not only to use scrambled discourse, but following Clark's (1973) thesis, treated passage length and content as random rather than fixed-effect variables. The data suggested that content and passage length exerted a greater influence on recall and recognition than the presence or absence of feedback (Langer & Keenan, 1984). Was feedback <u>that</u> content-specific? If so, this in turn created another threat to the general function of feedback, alluded to at the beginning.

From the outset, feedback strategies have been designed to achieve a high degree of concordance between learner outcomes and those endorsed by the text author. It has been axiomatically assumed this led to greater achievement, as evidenced on evaluation instruments designed by the system author. In other words, the basic assumption was that if you could direct the learner to arrive at a propositional network similar to that of the expert, achievement would be enhanced.

While we have not directly ascertained the final propositional network attained by our subjects, we were interested in using the sequence of sentences arrived at by subjects and comparing this to the original order (concordance). Perhaps naively we assumed that this might reflect a type of conceptual congruence. Moreover, what impact did this congruence have on level of achievement (Langer & Keenan, 1984; Keenan, Langer, & Medosch-Schonbeck, 1985)?

Method

Our subjects were 54 undergraduate psychology students drawn from Spring and Summer '84 classes at the University of Colorado. The passages were 13 and 26 sentences in length, describing the development of the first atomic pile at the University of Chicago during World War II (Fermi, 1957). The phrase "atom bomb", though, never appears per se.

The sentences were presented on a set of randomly ordered cards, with one sentence to a card. The subjects were informed that the purpose of the experiment was to determine how meaning is constructed. To assist the ordering of sentences, a wooden board with 35 slots was constructed. Cards could be rearranged freely, but always one at a time.

Each subject was given a practice task consisting of 11 sentences based on "The Goose That Laid the Golden Egg". If the subject was subsequently given feedback, five tokens were made available. These tokens could be used

to request feedback on the placement of a sentence. The feedback was either a "right" or "wrong", depending on whether a sentence was correctly placed with respect to the sentence immediately preceding it (based on the original order). In the no-feedback condition, subjects were unable to obtain confirmation or disconfirmation. The subjects then moved on to the experimental task, with the same feedback or no feedback condition experienced as in the practice task. In the feedback condition, they were again given five tokens. We used a limited feedback model because our pilot studies suggested that a very high availability of feedback led to a very passive-dependent reconstruction strategy.

The measures of achievement were recall and recognition. For recall, scoring was assessed as number of idea units. Recognition was measured by having the subjects select from pairs of sentences the original sentence (hence the tests consisted of 13 or 26 pairs of sentences), as distinguished from a paraphrase. Half the subjects in each group took the achievement measures immediately, while the other half delayed a week (but were not informed about the memory measures). The final factorial design was 2 (13- or 26-sentences) x 2 (feedback - no-feedback) x 2 (immediate-delayed). In addition a control group (N=6) was asked to read the 13-sentence scrambled order twice without any demands for reconstruction, and were then tested immediately.

Besides recall and recognition the other dependent variables were concordance (tau) with the original sentence order, number of tokens used, and time to completion.

Analyses

The critical measures for the purposes of this paper are recall, recognition, and concordance (tau).

To assess percentage recall, the 13- and 26-sentence passages were decomposed into idea units (Bovair & Kieras, 1981). The 13-sentence passage yielded 57 idea units, while the 26-sentence passage had 107.

The ANOVA data are given in Table 1.

Insert Table 1 about here

The means and standard deviations are given in Table 2.

Insert Table 2 about here

Number of sentences was significant ($F(1,40)=5.75$, $p<.02$), along with delay ($F(1,40)=9.79$, $p<.003$). There was no effect for feedback, and no interaction effects.

The respective percentage recall means scores were 28.09 and 20.71 for the 13- and 26-sentence passages, and 29.21 in the immediate condition versus 19.59 for the delay. A shorter passage under immediate testing produced the greatest recall, which was not that surprising. Again, the absence of a feedback effect on recall.

ANOVA for percentage recognition scores is given in Table 3.

Insert Table 3 about here

There were significant main effects for all three independent variables: NS ($F(1,40)=16.73$, $p<.001$), FB ($F(1,40)=16.97$, $p<.001$), and DL ($F(1,40)=13.19$, $p<.001$). Although there were interaction effects, we used a rule of thumb which suggested ignoring interactions where $p>.01$. The means are given in Table 4.

Insert Table 4 about here

The percentage recognition means were 76.01 and 64.21 for 13 versus 26 sentence, respectively; 76.13 and 64.17 respectively for feedback versus no feedback; and 75.42 versus 64.88 immediate versus delayed, respectively. Unlike recall, recognition was affected by feedback. Here the 13 sentence group, with feedback, and immediate testing had the highest recognition scores.

The control group, who read the 13 sentence passage in the scrambled order, were compared to the group receiving the same number of sentences, no feedback, and immediate testing. The 13-sentence no-feedback and control group mean recall percentages were 35.17 and 34.25 respectively, and 75.7 and 86.6 percent for recognition respectively. These differences were statistically non-significant.

Table 5 presents the ANOVA data for tau.

Insert Table 5 about here

For tau, the main effect for feedback was significant ($F(1,40)=5.04$, $p<.03$). The means are given in Table 6. For feedback the mean tau (.55)

Insert Table 6 about here

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was significantly higher than under the no-feedback condition (.34). However, the simple rs between tau and recall (-.03) and recognition (.16) were not statistically significant, further suggesting the idiosyncratic nature of the processing.

The number of tokens used, time, and move were all higher in the feedback condition, replicating previous research (Langer & Keenan, 1984).

Discussion

This is undoubtedly the most agonizing part of the paper. Our decision to go to a non-contrived text has uncovered a whole new set of problems regarding feedback, and perhaps even text processing

The most immediate concern is that these findings lend clear support to Clark's (1973) warning. The choice of materials is clearly a random variable. Indeed, in this study we used sentences from the same passage used in the first experiment (Langer & Keenan, 1984), except that we did not edit any of the sentences in an attempt to simplify them. This modest difference produced several new findings and erased others.

A second issue is that the reconstruction process was taken seriously by our subjects. Subjects in the control group read the 13-sentence passages in less than eight seconds per try, while the experimental group took close to an average of eight minutes to reconstruct the sentence structure. Yet this difference in processing time did not result in any statistically significant differences in either recall or recognition. Indeed seven of our subjects (across all experimental conditions) were able to recall 30 or more idea units from scrambled text. The implication here is some set of syntactical or local coherence cues, which provides a basis for episodic rote memory.

We originally assumed that the process of assembling the sentences would provide a basis for either developing or modifying an associative network which would enhance retrieval as measured by recall. The propositional overlap between and among propositions, a construct categorized by van Dijk and Kintsch (1983) as "local coherence" logically should have assisted the sentence ordering. The data would suggest that,

since the effect of feedback on tau was significant. However, neither recall nor recognition was correlated with tau.

Our present conclusion is that feedback is being used in some idiosyncratic manner, depending on the strategies available to the learner, as well as the knowledge base. For example, some subjects used their tokens throughout reconstruction, while others saved the tokens to confirm their judgments at the end of the process. That the subjects had differing schemata available was evident from recall protocols in which the Germany of World War II was designated as West Germany. You can feel quite old at times.

Right now our research is continuing along lines of familiarity and propositional interdependence. Many of our cherished beliefs about feedback have been considerably diminished, but this may be all for the good, considering the current state of the art.

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Table 1

ANOVA: Percentage Recall Scores.

Source	SS	Df	MS	F	Sig
Mean Effects	1869.40	3	623.13	5.49	.003
NS	658.69	1	652.69	5.75	.02
FB	105.02	1	105.02	.93	.342
DL	1111.69	1	1111.69	9.79	.003
2-Way Interactions	374.73	3	124.91	1.10	.360
NSxFB	31.69	1	31.69	.28	.600
NSxDL	325.52	1	352.52	2.67	.09
FBxDL	17.52	1	17.52	.154	.670
3-Way Interactions	7.52	1	7.52	.07	.80
NSxFBxDL	7.52	1	7.52	.07	.80
Explained	2251.65	7	321.66	2.83	.017
Residual	4541.84	40	113.55		
Total	6793.48	47	144.54		

Table 2

Percentage recall scores: Means and standard deviations.

Variable	Mean	SD
13-sentence	28.09	12.97
26-sentence	20.71	9.94
feedback	22.92	13.30
no-feedback	25.88	10.67
immediate	29.21	13.33
delayed	19.59	8.33

Table 3

ANOVA: Percentage recognition scores.

Source	SS	Df	MS	F	Sig
Mean Effects	4741.73	3	1580.58	15.63	.001
NS	1692.19	1	1692.19	16.73	.001
FB	1716.02	1	1716.02	16.97	.001
DL	1333.52	1	1333.52	13.19	.001
2-Way Interactions	680.73	3	226.91	2.24	.10
NSxFB	99.19	1	99.19	.98	.33
NSxDL	438.02	1	438.02	4.33	.04
FBxDL	143.52	1	143.52	1.42	.24
3-Way Interactions	438.02	1	438.02	4.33	.04
NSxFBxDL	438.02	1	438.02	4.33	.04
Explained	5860.48	7	837.21	8.28	.001
Residual	4045.50	40	101.14		
Total	9905.98	47	210.77		

Table 4

Percentage recognition scores: Means and standard deviations.

Variable	Mean	SD
13-sentence	76.08	13.04
26-sentence	64.20	13.68
feedback	76.13	12.92
no-feedback	64.17	13.75
immediate	76.42	11.96
delayed	64.88	15.15

Table 5

ANOVA: TAU

Source	SS	Df	MS	F	Sig
Mean Effects	.71	3	.24	2.20	.10
NS	.06	1	.06	.56	.46
FB	.54	1	.54	5.04	.03
DL	.11	1	.11	.99	.33
2-Way Interactions	.36	3	.12	1.11	.36
NSxFB	.08	1	.08	.75	.39
NSxDL	.17	1	.17	1.55	.22
FBxDL	.11	1	.11	1.03	.32
3-Way Interactions	.04	1	.04	.34	.56
NSxFBxDL	.04	1	.04	.34	.56
Explained	1.10	7	.16	1.47	.21
Residual	4.28	40	.11		
Total	5.38	47	.12		

Table 6

Tau: Mean scores and standard deviations.

Variable	MEAN	SD
13-sentence	.48	.38
26-sentence	.41	.30
feedback	.55	.34
no-feedback	.34	.31
immediate	.40	.31
delayed	.49	.37